CALIBRATION STANDARD REQUIREMENT

FOR AN

AUTOMATIC RECORDING VIBRATION CALIBRATION SYSTEM

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PROCUREMENT PACKAGE

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AUTOMATIC RECORDING VIBRATION CALIBRATION SYSTEM

1. SCOPE

1.1 Scope. This requirement defines the mechanical, electrical and electronic characteristics for an automatic recording vibration calibration system. This equipment is intended to be used by Navy personnel in shorebased laboratories to calibrate accelerometers and other vibration equipment. For the purposes of this requirement, the automatic recording vibration calibration system shall be referred to as the ARVCS.

2. APPLICABLE DOCUMENTS

2.1 Controlling Specifications. MIL-T-28800, “Military Specification, Test Equipment for use with Electrical and Electronic Equipment, General specification for,” and all documents referenced therein of the issues in effect on the date of this solicitation shall form a part of this requirement.

2.1.1 The ARVCS will be complete with an electro-dynamic shaker and control console, which includes system controls, protective devices, and calibration instrumentation. The vibration exciter shall provide a mounting surface for the accelerometer and/or vibration pickup to be calibrated. An internal reference accelerometer shall be supplied as specified in detail herein.

2.1.2 Exceptionally pure rectilinear motion of the shaker, very low acceleration and velocity distortion, and the internal mounting of a reference accelerometer shall contribute to the stability, repeatability and reliability of quality calibration. Conservative equipment ratings along with suitable instrumentation developed specifically for calibration shall minimize the usual variables affecting accuracy and repeatability over a frequency range of 2 Hz to 10,000 Hz.

2.1.3 An automatic computing and plotting system will be provided to give readout of characteristics of accelerometer under test on an X-Y recorder.

3. REQUIREMENTS

3.1 General. The ARVCS shall conform to the Type II, Class 5, Style E requirements as specified in MIL-T-28800 for Navy

shipboard and shorebased use as modified below. The use of material restricted for Navy use shall be governed by MIL-T-28800.

3.1.1 Design and Construction. The ARVCS design and construction shall meet the requirements of MIL-T-28800 for Type II equipment.

3.1.2 Power requirements. The ARVCS shall be designed for operation from 120 V, 1 kVA 60 Hz, single phase power for instrumentation, and 3 phase either 208 V, 240 V, or 480 V, 6 kVA 60 Hz for power requirements.

3.1.2.1 Fuses or Circuit Breakers. Fuses or circuit breakers shall be provided. If circuit breakers are used, both sides of the power source shall be automatically disconnected from the equipment in the event of excessive current. If fuses are used, only the line side of the input power line, as defined by MIL-C-2877, shall be fused. Fuses or circuit breakers shall be readily accessible.

3.1.2.2 Power Connection. The requirements for power source connections shall be in accordance with MIL-T-28800.

3.1.3 Lithium Batteries. Per MIL-T-28800, lithium batteries are prohibited without prior authorization. A request or approval for the use of lithium batteries, including those encapsulated in integrated circuits, shall be submitted to the procuring activity at the time of submission of proposals. Approval shall apply only to the specific model proposed.

3.2 Environmental Requirements. The ARVCS shall meet the environmental requirements for a Type II, Class 5, Style E equipment with the deviations specified below.

3.2.1 Temperature and Humidity. The ARVCS shall meet the conditions below:

	Temperature (°C)	Relative Humidity (%)
Operating	10 to 30	95
	30 to 40	75
Non-operating	-40 to 70	Not Controlled

3.2.2 Electromagnetic Compatibility. The electromagnetic compatibility requirements of MIL-T-28800 are limited to the following areas: CE01, CE03, CS01, CS02, CS06, RE01, RE02 (14 kHz to 1 Ghz), and RS03.

3.3 Reliability. Type II reliability requirements are as specified in MIL-T-28800.

3.3.1 Calibration Interval. The ARVCS shall have an 85% or greater probability of remaining within tolerances of all requirements at the end of a 12 month period.

3.4 Maintainability. The ARVCS shall meet the Type II maintainability requirements as specified in MIL-T-28800 except the lowest discrete component shall be defined as a replaceable assembly. Certification time shall not exceed 60 minutes.

3.5 Performance Requirements. The ARVCS shall provide the following capability as specified below. Unless otherwise indicated, all requirements shall be met following a 30-minute warm-up period.

3.5.1 Force Output Vector. The ARVCS shall have a force output vector of 300 pounds.

3.5.2 Frequency Range. The ARVCS shall have a frequency range of 2 Hz to 10,000 Hz.

3.5.3 Table Displacement. The ARVCS shall have a table displacement of 0.5 inch displacement peak to peak. (3/4 inch displacement when shaker includes low frequency modification.)

3.5.4 Velocity. The ARVCS shall have a velocity of at least 50 inches/sec peak with a 0.06 pound payload and full field in shake except as limited by 0.5 displacement or 100g.

3.5.5 Minimum Acceleration. Minimum acceleration levels shall be obtainable as follows:

100 g peak while calibrating typical piezoelectric accelerometers using the built-in “back-to-back” accelerometer mounting from 125 Hz to 10,000 Hz (with optional 3/4 inch stroke and velocity feedback low frequency modifications the acceleration is reduced to 75 g peak from 8,000 to 10,000 Hz.

75 g peak with 1.0 pound rigid mass payload 92 Hz to 7500 Hz.

37.5 g peak with 5 pound rigid mass payload 46 Hz to 5500 Hz.

3.5.6 Acceleration Distortion. The ARVCS shall have the following acceleration distortion systems.

3.5.6.1 Standard System. The acceleration waveform harmonic distortion as measured from the output of the reference accelerometer and signal conditioner with an distortion analyzer at any frequency in the frequency range from 25 Hz to 10,000 Hz shall not exceed 1.5% at l00 g. Similarly, the acceleration waveform harmonic distortion at any frequency range from 25 Hz to 10000 Hz shall not exceed 1.5% at 1 g and 3% at 10 Hz and 1 g. The acceleration distortion stated shall apply with the system operating under amplitude servo control with no load or a typical piezoelectric accelerometer attached to the table.

3.5.6.2 Optional Low Frequency Modified System. The acceleration waveform harmonic distortion as measured from the reference accelerometer and signal conditioner with an distortion analyzer at any frequency in the frequency range from 125 Hz to 8,000 Hz at 100 g peak and from 8,000 Hz to 10,000 Hz at 75 g peak shall not exceed 1.5%. Similarly, the acceleration waveform harmonic distortion at any frequency within the range of 10 to 10,000 Hz shall not exceed 1.5% at 1 g peak. At 5 Hz and 0.3 inch peak to peak displacement the distortion shall not exceed 2%.

3.5.7 Cross Axis Motion. The ARVCS cross axis motion shall remain approximately a constant percentage of the axial motion independent of acceleration level and shall be measured at 10g in the driven direction or 0.3 inch peak-to-peak, whichever is less, using two small accelerometers mounted “back-to-back” in a horizontal plane centered on the table or rigid table payload. The accelerometers will be positioned to measure cross axis motion approximately parallel to and perpendicular to the shaker trunnion axis. The cross axis motion expressed as a percent of the driven motion shall not exceed the amounts shown in the two directions measured.

Table Load Lbs	Frequency Band Hz	Max. Cross Axis Motion
0.06	5-400	5%
0.06	4000-10,000	25%
1.0	5-2500	5%

3.5.8 Hum and Noise. The background hum and noise level, including the mechanical vibration in the table as well as the electrical contributions in the readout instrumentation, shall be less than 0.005 g rms when the amplitude of vibration is turned to zero on the control panel and no load is attached to the table.

3.5.9 Critical Frequencies of Operation. There shall be no critical operating frequencies due to suspension resonance, armature resonance, cross axis motion, acceleration distortion, etc., which would preclude frequency sweeping at 100 g or calibrating at any frequency in the operating frequency range.

3.6 Operating Requirements. The ARVCS shall provide the following capabilities.

3.6.1 Shaker. The first fundamental axial resonance mode of the shaker armature with the table unloaded utilizing the reference accelerometer shall be at least 6700 Hz (6000 Hz with 3/4 inch stroke modification).

3.6.1.2 Shaker Table Suspension System. The Shaker Table Suspension System shall be designed to assure rectilinear motion in the direction perpendicular to the table surface. It will be free of all mechanical resonances which introduce distortion into the table motion. The suspension system shall include axial springs of rubber or rubber-like material free from mechanical resonant effects. The axial springs shall be supplemented with damped radial restraints of the same kind in two planes perpendicular to the axis of the armature. The radial restraints shall be rigidly attached to the table on the inner end and to the outer end support. The damped radial restraints shall conduct the armature coil current. No rolling, sliding or metal on metal parts shall be used for the purpose of guiding the table during axial motion. The suspension shall be free of small working parts which can break, wear, require adjustment with use or introduce background mechanical noise or acceleration distortion in the table motion. The table suspension shall not require critical adjustments upon which good table motion depends. The suspension shall be suitable for 100 g table operation at any frequency without deterioration or introduction of distortion from 100 Hz to 10,000 Hz. The axial suspension stiffness shall be 50 lbs/inch nominal.

3.6.1.3 Shaker Table Requirements. The Shaker table shall have a replaceable flanged insert in the center, mounting a reference

accelerometer on the inner end so that screwing an accelerometer to be calibrated to its surface without other adapters gives a “back-to-back” mounting suitable for use up to 10,000 Hz. The reference accelerometer shall be easily removable by unscrewing four socket head cap screws which fasten the flanged insert to the table. The flanged insert itself shall not be screwed into the table, but held in place by attaching screws. The insert shall be made from a stiff, electrically insulating ceramic material with lapped flat surfaces for reference and unknown accelerometer attachment. The insert design shall minimize “diaphragming” of the accelerometer mounting surface at all frequencies. A metal thread shall be provided in the ceramic table insert for attaching the “unknown” accelerometer to improve service life. The reference accelerometer cable shall be easily accessible and replaceable without opening up or disassembly of shaker in any way. A removable outer top plate shall be attached to the table top to provide a flush surface with the center flanged insert. The removable outer top plate shall allow drilling and tapping for transducer attachment holes. A clearance slot in this outer top plate shall allow the reference accelerometer cable to be brought out above the shaker cover.

3.6.1.4 Shaker Mounting. The shaker shall be rigidly mounted on its base. Vibration isolation from the supporting floor shall consist of resilient pads under the base supplied by the vendor giving a vertical natural frequency of 10 Hz to 12 Hz approximately.

3.6.1.5 Shaker balance. The exciter shall be balanced so that it may be rotated on its trunnions by one person. Locking in any position is required. Rotations through 360° shall be possible.

3.6.1.6 Magnetic Fields. Stray magnetic field measured at any point 1.0 inch above the table top shall not exceed 5 gauss with full shaker field.

3.6.1.7 Overtravel Switch. An electrical overtravel switch shall be provided to shut off the driving power if the shaker table displacement exceeds the rated value.

3.6.1.8 Stops. Mechanical cushioned stops shall be provided to prevent excessive shaker table excursions.

3.6.1.9 Thermal Over-temperature Switch. A thermal switch shall be provided within the Exciter to furnish over-temperature protection for the field coil.

3.6.1.10 Shaker Cooling. The shaker field shall be cooled using clean tap water supplied by the purchaser using less than 1 gpm.

The armature coil shall be air cooled. A remote blower connected to the shaker with a flexible duct shall be provided.

3.6.1.11 Performance Curves. Performance curves on table acceleration waveform distortion and cross axis motion shall be furnished with the proposal. Certified test data of table distortion and cross axis motion taken on the system at the time of the final checkout shall be included in the Operating and Maintenance Manuals furnished with the system.

3.6.1.12 Internal Accelerometer. The table shall have an internal accelerometer suitably mounted so that a “back-to-back” mounting is provided for use up to 10,000 Hz by simply screwing the accelerometer to be calibrated to the table center. The full 100 g rating shall be available with this “back-to-back” mounting for typical small piezoelectric accelerometers attached.

3.6.1.12.1 Accelerometer Mounting Volume. Space for the internal accelerometer shall be sufficient to permit installation of accelerometers with the following envelope dimensions: 0.760 inches diameter by 0.880 inches high (1.93 cm diameter by 2.24 cm high).

3.6.1.13 Shaker Protection. The table surface shall be continuous with a peripheral seal along with a protective cover on the shaker to preclude the entry of foreign material into the shaker.

3.6.1.14 Continuous Force Rating. The shaker shall have a continuous force rating of at least 50 pounds with the cooling blower inoperative.

3.6.1.15 Shaker Armature Acceleration Magnification Factor. The shaker armature acceleration magnification factor at the armature axial resonance frequency shall be less than 12 in order to limit harmonic distortion in the acceleration waveform and to limit the amplitude servo compression at the resonant frequency for improved recorded calibration accuracy. The magnification factor shall be defined as the ratio of the acceleration at the armature resonant frequency to the acceleration at 1/3 of the resonant frequency using the same driving voltage at the shaker armature coil for both frequencies with no load on the shaker table and acceleration measured by the internal reference accelerometer.

3.6.2 Control Console. The ARVCS shall have a control console that meets the following requirements.

3.6.2.1 Work Space. A desk type console shall be provided consisting of a writing surface across two 19 inch bays with vertical panels behind the writing surface giving approximately 30

inches of usable panel space in each bay. The console shall be of modular design allowing later additions and modifications if desired.

3.6.2.2 Console Components. The console shall house the power amplifier and field supply for the shaker as well as the signal source and calibration instrumentation.

3.6.2.3 Other Console Equipment. The Control Console shall contain all the necessary equipment and instrumentation required to control the system for manual and automatic frequency sweeping with amplitude servo controlled sinusoidal operation.

3.6.2.4 Console Cooling. The console shall be adequately cooled by filtered forced air.

3.6.2.5 Console Wiring. All connections and inter-wiring of the console components shall be accomplished within the enclosure leaving the front panels free of instrument interconnection wiring.

3.6.2.6 Console Connectors. All interconnecting cables from the console to other major system components shall be terminated with connectors at the console.

3.6.2.7 Console Access. A panel shall be mounted on the rear of the console to provide a convenient method of disconnecting all cables between the shaker and console with the exception of the accelerometer cables which shall connect between the shaker and front panel.

3.6.2.8 Console Mobility. The console shall be on casters for easy positioning relative to the shaker.

3.6.3 Power Amplifier. The ARVCS shall have a power amplifier that meets the following requirements.

3.6.3.1 Amplifier Capability. The power amplifier shall provide adequate power to drive the shaker to the performances specified in this requirement. No impedance matching changes or load power factor corrections shall be required.

3.6.3.2 Amplifier Distortion. The amplifier distortion shall be less than 0.25% when driving the shaker to 100 g from 200 Hz to 10,000 Hz with low distortion oscillator.

3.6.3.3 Hum and Noise. The hum and noise shall be 85 dB down with respect to full output.

3.6.3.4 Input Signal. Input signal shall be less than 10 volts rms for full rated output.

3.6.3.5 Amplifier Construction. The amplifier shall be solid state, air-cooled, direct coupled, using Westinghouse premium quality transistors (or equivalent quality) in the output.

3.6.3.6 Amplifier Control. Amplifier control shall include voltage and current limiting capability to prevent damaging of the overdrive. The amplifier control shall have interlocks to automatically remove amplifier power when any door is opened.

3.6.3.7 Shaker Current Meters. The current in the shaker armature coil shall be indicated on two collector current meters in the front panel of the power amplifier.

3.6.4 Shaker Field Supply. The ARVCS shall have a shaker field supply which provides the following requirements.

3.6.4.1 DC Power. The field supply shall be capable of supplying the required DC power to the shaker field.

3.6.4.2 Filtering. The field supply shall be filtered consistent with the system noise level of paragraph 3.5.8.

3.6.4.3 Field Current Meter. A field current meter shall be supplied in the console panel.

3.6.5 Automatic Shaker Control. The automatic shaker control shall provide the following requirements.

3.6.5.1 Sweep Sine Generator. The shaker control shall have a sweep sine generator.

3.6.5.1.1 Frequency Ranges. Three decade frequency ranges shall be automatically swept without switching including:

2 Hz to 2000 Hz
5 Hz to 5000 Hz
10 Hz to 10000 Hz

3.6.5.1.2 Frequency Counter. A five place digital display shall give 0.1 Hz resolution displayed once each second switchable to 1.0 Hz resolution displayed ten times each second.

3.6.5.1.3 Sweeptime. The sweeptime range shall be a minimum of 1.0 to 99.9 minutes in 0.1 minute intervals, digital switch selectable.

3.6.5.1.4 Number of Sweeps. The number of sweeps shall be a minimum of 1 to 99, digital switch selectable.

3.6.5.1.5 Recording Pen Lift. The automatic recording pen shall automatically lower at the beginning of the frequency sweep and lift at the end of the sweep.

3.6.5.1.6 Log DC Output. The Log DC output shall be 1.32 volt DC nominal corresponding to 10,000 Hz independent of frequency range selected with 0.4 volts change nominal per decade.

3.6.5.1.7 Construction. Solid state, 5-1/4” panel height.

3.6.5.2 Amplitude Servo Control. The amplitude servo control shall meet the following requirements.

3.6.5.2.1 Frequency Range. The minimum frequency range shall be 2 Hz to 10,000 Hz.

3.6.5.2.2 Metering, Compression. The metering for compression shall be 0 to 70 dB.

3.6.5.2.3 Compression Speed. The compression speed range shall be 10 to 3000 dB/sec with automatic or manual control.

3.6.5.2.4 Input Voltage. The input voltage shall be 1 volt rms at full scale values of acceleration: g peak, velocity: inch/sec peak, displacement: inches peak to peak.

3.6.5.2.5 Log Frequency Input. The log frequency input shall be -0.15 to 1.32 at 10,000 Hz volts nominal DC from 2 Hz to 10,000 Hz.

3.6.5.2.6 Compressor (AGC) Amplifier.

3.6.5.2.6.1 Output. 7 volt rms for input of 1 volt rms.

3.6.5.2.6.2 Dynamic Gain Range. Greater than 70 dB.

3.6.5.2.6.3 Compression Characteristic. Linear from 10 to 70 dB.

3.6.5.2.6.4 Distortion. Less than 0.5% for normal compression speeds 5 Hz to 10,000 Hz.

3.6.5.2.6.5 Correction Accuracy. The correction accuracy shall be 30 dB/0.5 dB, 60 dB/1 dB.

3.6.5.2.7 Compression Modes. The compression modes shall be Off, Standby, Auto, Manual, and Switch Selectable.

3.6.5.2.8 Interlocks. Improper switching of compressor mode switch shall cause standby light to light and give full compression of output.

3.6.5.2.9 Filtering. The design shall incorporate a variable frequency filter slaved to the operating frequency, thereby attenuating higher frequency harmonics from the Sine Generator and other sources.

3.6.5.2.10 Shaker Response Compensation. A FLAT-BOOST Switch shall allow frequency sweeping at constant acceleration with minimum change in servo compression at the lower frequencies.

3.6.5.2.11 Output Voltage Control. A coarse and vernier control shall be provided to facilitate setting the system acceleration to the precise value desired.

3.6.6 System Controls. Lighted push button switches shall be provided for starting and standby operation including, PREAMP, STANDBY, OPERATE, and OFF positions.

3.6.7 Calibration Instrumentation. The calibration instrumentation shall provide two matched channels of instrumentation, one for the “built-in” reference accelerometer and the other for the accelerometer or velocity pickup under calibration. The calibration instrumentation shall give a direct numerical readout of the sensitivity of the accelerometer or velocity pickup under calibration using the comparison procedure (American Standards Association, Standard No. S2-19591).

3.6.7.1 Inputs.

3.6.7.1.1 Type. Single ended charge or voltage inputs at front panel BNC’s isolated from chassis.

3.6.7.1.2 Mode Selection. Locking toggle switch shall place instrument in charge or voltage mode of operation to agree with input connector used.

3.6.7.1.3 Mode Accuracy. Charge mode and voltage mode calibration accuracy shall be within ± 0.25%.

3.6.7.1.4 Impedance. 1K megohm resistance shunted by 10 pF capacitance in voltage mode and 1K megohm resistance shunted to 10 mfd capacitance in charge mode.

3.6.7.1.5 Dynamic Range. Linear to 10 volts peak in the Voltage Mode (all four sensitivity ranges); 10,000 pC peak in the Charge Mode (lowest three sensitivity ranges); and 100,000 pC peak (highest sensitivity range).

3.6.7.1.6 Ground Signal Rejection. Locking toggle switch shall permit rejection of ground loop signals when the case of the input transducer is grounded at the mounting location.

3.6.7.2 Outputs.

3.6.7.2.1 A-V-D. 1 V rms full scale output to represent acceleration, velocity, or displacement as selected by a three station push-button switch and a ten position full scale range switch. This output shall be located at both front and rear panels with paralleled BNC's.

3.6.7.2.2 Acceleration. (1) Normalized at 10 mV/g. Rear panel BNC. (2) Normalized at 100 mV/g. Rear panel BNC.

3.6.7.2.3 Velocity. Normalized at 100 mV/inch/sec. Rear panel BNC.

3.6.7.2.4 Displacement. Normalized at 1 V/inch DA. Rear panel BNC.

3.6.7.2.5 Impedance. Shall be less than 100 ohms in series with 180 mfd for all outputs except the 10 mV/g output, which may be 200 ohm output resistance.

3.6.7.3 Transfer Characteristics.

3.6.7.3.1 Sensitivity Selection. Four ranges with digital indication shall be provided in pC/unit or mV/unit as follows:

0.500 to 9.999
05.00 to 99.99
050.0 to 999.9
0500. to 9999.

The accuracy shall be ± 0.1% between the lowest three ranges and ± 0.5% on the highest range. Accuracy of four digit sensitivity selector shall be ± 0.025% full scale. Resolution of four digit sensitivity selector shall be ± 0.01% full scale.

3.6.7.3.2 Full Scale Ranges. Shall be selectable from 0.1 to 100 in a 1, 2, 5, 10 sequence for acceleration (g peak) and velocity (inch/sec). Displacement from 0.01 to 10 inch DA. Accurate within ± 0.1% between ranges. Edgewise panel meter shall provide indication of operating level in percent of full scale.

3.6.7.3.3 Frequency Response.

Acceleration:	±0.25% from 10 Hz to 5,000 Hz ±0.5% from 5 Hz to 10,000 Hz ±2% from 2 Hz to 20,000 Hz
Velocity:	±1% from 10 Hz to 2,000 Hz ±2% from 5 Hz to 5,000 Hz ±5% from 2 Hz to 10,000 Hz
Displacement:	±1.5% from 10 Hz to 200 Hz ±3% from 5 Hz to 500 Hz

Filtering: (1) Low pass acceleration filter shall provide a roll off that is down approximately 3 dB at 50 kHz. (2) High pass velocity and displacement filter shall be selectable at 2 Hz and 10 Hz for response flat within ± 2% at 10 Hz when in the “10 Hz” filter position.

3.6.7.3.4 Linearity. Linear within ± 0.25% of best straight line to 1 V rms full scale condition at A-V-D output.

3.6.7.3.5 Distortion. The distortion shall be less than ±0.25%.

3.6.7.3.6 Hum and Noise.

3.6.7.3.6.1 Voltage Mode. Less than 10 microvolts rms referred to the input on lowest full scale range.

3.6.7.3.6.2 Charge Mode. Less than 0.010 pC rms + 0.003 pC rms/1000 pF source capacitance referred to the input on lowest full scale range.

3.6.7.3.7 Stability. Combined stability shall be within ± 0.7% for line voltage variations from 105 to 125 V AC, for temperature variation from 40°F to 120°F, and for a time period of three months.

3.6.7.4 Calibration.

3.6.7.4.1 Mode Selector. A three position rotary switch shall select the standard instrument operational mode; the SERIES mode to permit instrument calibration through a series 1000 pF ± 0.25% internal capacitor when in the Charge mode of operation, and the TEST mode to provide 1 V rms full scale output independent of front panel control settings.

3.6.7.4.2 Oscillator Input. A front panel BNC shall be provided for the calibration oscillator input when operating in the SERIES or TEST modes.

3.6.7.5 Physical.

3.6.7.5.1 Construction. All solid state

3.6.7.5.2 Size. 3-1/2 inch high panel for rack mounting.

3.6.7.6 Digital Calibration Comparator.

3.6.7.6.1 Frequency Range. The digital calibration camparator shall have a minimum frequency range of 2 Hz to 10,000 Hz.

3.6.7.6.2 Inputs.

3.6.7.6.2.1 Reference Input. Vibration signal from Model 1611-3 paralleled isolated BNC connector.

3.6.7.6.2.2 Unknown Input. Vibration signal from Model 1611-2 paralleled isolated BNC connector.

3.6.7.6.3 Outputs.

3.6.7.6.3.1 Monitor Output. Provides either reference or unknown input at rear panel BNC as determined by front-panel push button switch.

3.6.7.6.3.2 DC Output. Provides 1.000 V DC output for 1.000 V AC rms at switch-selected input.

3.6.7.6.3.3 Digital Meter. 3-1/2 digit meter reads DC output voltage.

3.6.7.6.4 Output Filtering. 3-pole low-pass filtering, switch-selectable for 2 Hz and 5 Hz operation. Provides less than ± 0.2% jitter in meter indication at lowest frequency.

3.6.7.6.5 Indication Accuracy. The indication accuracy shall be at least ± 0.2% at 100 Hz.

3.6.7.6.6 Frequency Response. The frequency response shall be ± 0.5% at 2 Hz and 10,000 Hz.

3.6.7.6.7 Input Impedance. The input impedance shall be 100 k ohm in series with 10 uF.

3.6.7.6.8 Power. 105-125/210-250 V AC, 50-60 Hz, 10 VA.

3.6.7.6.9 Size. The maximum size shall be 3-1/2 inches high x 10 inches wide x 11 inches deep.

3.6.7.7 Automatic Recording Accessories.

3.6.7.7.1 Calibration Computer.

3.6.7.7.1.1 Frequency Range. The frequency range shall be a minimum of 2 Hz to 10,000 Hz

3.6.7.7.1.2 Response Time. Two filter time constants shall be provided with a front panel selector switch to limit pen jitter. The high damping position shall allow plotting from 2 Hz to 10,000 Hz. The low damping position shall allow plotting 20 Hz to 10,000 Hz.

3.6.7.7.1.3 Plotting Speed. For typical accelerometers with less than 15% deviations, a plot from 20 Hz to 10,000 Hz shall be made in three minutes. Plots from 10 Hz to 10,000 Hz shall also be made in three minutes with the damping in high below 20 Hz and manually switches to low above 20 Hz.

3.6.7.7.1.4 Plotting Scales. Standard semi-log graph paper shall be usable, with a linear % deviation on the Y axis and log frequency on the X axis. Adjustment shall be available giving 5% or more deviation per inch on the Y axis and for 10 Hz to 10,000 Hz on either 3 cycle or 5 cycle standard paper on the X axis.

3.6.7.7.1.5 Plotted Curve. It shall be the % deviation of the unknown relative to the reference channel as a function of frequency.

3.6.7.7.1.6 Plotting Accuracy. Typical plots run a 5% deviation/inch shall be readable and repeatable with 1/4%. The error in the plotted calibration curve including shaker amplitude servo, conditioning instruments providing the “reference” and “unknown” AC input to the computer, shall not exceed 1/4% with up to 5% deviation of the “unknown” relative to the “reference” from

10 Hz to 5,000 Hz. The error shall not exceed 1/2% under the same conditions from 5,000 Hz to 10,000 Hz.

3.6.7.7.1.7 "g" Range. Full scale ranges of 0.1, 0.2, 0.5, 1 through 100 g on the standardizers shall allow calibrations at these vibration levels without additional adjustments affecting the recording.

3.6.7.7.2 Calibration Plotter.

3.6.7.7.2.1 Paper Size. Up to 8-1/2 inches x 11-1/2 inches.

3.6.7.7.2.2 Paper Hold Down. Electrostatic.

3.6.7.7.2.3 Pen Control. Automatic control by Sweep Sine Generator.

3.6.7.7.2.4 Pen Type. Nylon tip, replaceable cartridge.

3.6.8 Accessory Instrument Mounting. Control console shall be supplied with space to accommodate optional additional instrumentation with 120 volt receptacles within the console to supply the input power.

3.6.9 Cables. All interconnecting cables between console and shaker shall be supplied as follows:

Power cable 15 ft long (connected at rear of console)

Accelerometer 10 ft (connected front of panel)

Flexible supply and drain water hose between shaker and plumbing connections - 25 ft. Water filter and automatic flow controls shall be supplied by vendor.

3.7 Manual. At least two copies of an operation and maintenance manual shall be provided. The manual shall meet the requirements of MIL-M-7298.

3.7.1 Calibration Procedure. A calibration procedure in accordance with MIL-M-38793 shall be provided.